Finding of the LWS Science Architecture Team
May 2001 meeting

#1: Overall guiding principles

A principal finding of the SAT is that the governing principle under which LWS needs to be developed is that it is an end-to-end system. LWS must be fundamentally concerned with the processes, and in particular the linkages, responsible for the influence of the Sun on Earth.

To that end,

1) There needs to be an interval of time, for a period of years, when all elements of the coupled system are observed concurrently.

2) The management of the program must continuously reinforce the end-to-end nature of LWS through appropriate linkages of the different science disciplines.

3) Emphasis must be placed on quantitative measurements within the Sun-heliosphere-Earth system, to ensure that the inputs from one component of the system to the next are properly measured.

4) The modeling and theoretical efforts need to emphasize the coupled nature of the Sun-heliosphere-Earth system, and serve as a unifying theme for the entire LWS program.

Finding of the LWS Science Architecture Team
May 2001 meeting

#2: SDO solar instrument payload

The LWS SAT agrees with the SDO/Science Definition Team that the Helioseismograph/Magnetograph Imager (HMI), Atmospheric Imager Assembly and Spectrometer (AIA and AIS), and EUV Irradiance Spectrometer (EUVIS) instruments together constitute core solar measurements for the LWS program. These instruments are formulated at minimal required capabilities in the May 2001 SDO/SDT draft report.

The SAT finds that vector magnetographic capabilities and coronagraphic observations from Earth perspective are additional critical observations for LWS. These should be available either on SDO, or another identified source including ground-based observatories during much of the LWS program.

Finding of the LWS Science Architecture Team
May 2001 meeting

#3: SDO Geospace Instrumentation

The LWS SAT has been briefed on the development of the Solar Dynamics Observatory concept, whose Announcement of Opportunity release is expected in the next few months. As the first spacecraft in the LWS program, the SAT has discussed the possibility of including Geospace Instrumentation on this three-axis stabilized spacecraft, which is in a geosynchronous orbit.

Geospace science measurements that could, in principle, be carried out on SDO can address key LWS issues in both the Radiation Environment and in the Ionosphere/Thermosphere.

Key Radiation Environment measurements are (in order of priority) (1) energetic particles and magnetic field; (2) plasma, and (3) energetic neutral atoms (ENAs).

Key Ionosphere/Thermosphere measurements are ENA and UV imaging for neutral and ionospheric densities and auroral emissions.

The SAT sees obvious value in all these observations for LWS science objectives; however we do not presently have enough information to evaluate the science return against the existing resource constraints or other implementation possibilities. The SAT finds that an investigation of these trade offs be carried out by NASA HQ and the LWS mission scientists would make is possible to determine if including Geospace Instrumentation on SDO would be a desirable use of LWS resources.

Finding of the LWS Science Architecture Team
May 2001 meeting

#4: Theory / Modeling and Data Analysis

The LWS SAT holds the Theory/Modeling and Data Analysis (TM&DA) component of the program as a critical end product which uses both physics-based understanding and experimental measurements to test our knowledge of the Sun-heliosphere-Earth system. Our ability to meet LWS goals of environmental specification, research into nowcasting, and forecasting all culminate in the models used to describe the system.

The current program includes focused individual investigations of key science gaps, in the traditional manner of SEC research programs. The LWS finds that an additional component of the TM&DA program is needed: development of end-to-end models for selected Sun-Earth linkages. The efforts envisioned here are well beyond the typical scope of existing grants, and would develop models that emphasize boundaries and linkages among systems and phenomena in order to provide a comprehensive picture. Examples of such end-to-end models are: CME events from eruption in the corona, to interplanetary propagation, to impact on the magnetosphere, to input to the thermosphere/ionosphere; another example is substorms, and their effects on the magnetosphere, thermosphere and ionosphere; a third example is the impact of the solar cycle on active regions in which EUV radiation is enhanced, and the effect of the resultant irradiance modulation on the thermosphere.

The SAT has considered a number of ground-rules for such programs including an open use policy for the full SEC community and periodic review of progress. The SAT anticipates that such programs could require resources of $0.5-1.0M/year, for a initial period of ~3 yrs, with evaluation by NASA to see if the project should be continued. The SAT considers it desirable to have multiple groups working on such projects, providing that sufficiently compelling proposals are identified in the peer review process.

Therefore, the SAT finds that an amendment to the NRA should be released as early as possible that will request:

" end-to-end models that emphasize boundaries and linkages among systems and phenomena in order to provide a comprehensive picture. "

Finding of the LWS Science Architecture Team
May 2001 meeting

#5: Instrument Development

The LWS SAT finds that NASA should immediately begin to fund new concepts, prototyping, and development of measurement capabilities in support of LWS objectives. The LWS recognizes that innovative, compact, and cost-effective instrumentation that maximizes access to space is crucial for achieving goals of LWS. Rapid advances in technology beyond that currently available show great promise.

The objectives of LWS require compact instruments, multiple-small spacecraft and/or launches of opportunity focusing on both remove and in situ measurements. Achieving this objective requires smaller, less resource intensive instruments. Some of these instruments may be unique to LWS.

The LWS SAT finds that in the next NASA NRA, it would be highly desirable to include instrument development in support of LWS needs.